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A NEW SPECIES OF MIDGE OF THE GENUS *FORCIPOMYIA* MEIGEN (DIPTERA: CERATOPOGONIDAE) FROM NORTH AMERICA[1]

PAUL G. BYSTRAK AND DONALD H. MESSERSMITH

Department of Entomology, University of Maryland, College Park, Maryland 20742.

Abstract.—A new species of biting midge, *Forcipomyia* **pinicola**, n.sp., was discovered under the bark of dead trees. Records of this species indicate it is found throughout the eastern United States and Canada. It is most closely related to the widespread *F. bipunctata* (Linnaeus).

While collecting immature ceratopogonids the following new species was obtained from the bark of dead trees. For an explanation of adult terminology see Wirth and Messersmith (1971); for immature terminology see Saunders (1924). Measurements were obtained in the manner proposed by Chan and LeRoux (1965). All proportions are actual measurements expressed in microns.

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All specimens are mounted in phenol-balsam on microscope slides after the manner of Wirth and Marston (1968). Types of this new species will be deposited in the USNM; paratypes will be deposited in the Canadian National Collection (CNC), Ottawa; British Museum (Natural History), London; Florida State Collection of Arthropods, Gainesville; and California Academy of Sciences (CAS), San Francisco.

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Forcipomyia (*Forcipomyia*) *pinicola*
Bystrak and Messersmith, NEW SPECIES
Figs. 1–3

Diagnosis.—A medium sized *Forcipomyia* (*Forcipomyia*) most closely related to *F. bipunctata* (L.) but differing from that species by the following combination of characters: Female with wing unadorned; lanceolate scales on all tibiae; male genitalia with narrow, deep, caudomedian notch on 9th sternum; pupa with long dorsal abdominal processes; larva with branched *t*, *u*, and *y* hairs on head.

Egg.—Shaped as illustrated (Fig. 1f).

Larva.—Length (4th instar) 3.9 mm. Body a milky, nearly transparent color; except for sclerotized head. Antenna 2-segmented, short and clear; *p* hair narrow hastate, *q* hair half hastate; both about same length as antenna, *t*, *u*, and *y* hairs branched (Fig. 1c). Prothoracic pseudopod biramous (Fig. 1e), split for nearly entire length; with 5 medioventral, sclerotized hooks on each side. Body segments (Fig. 1d) with *a* hairs about as long as *p* hairs of head, broadly hastate in shape, completely clear and with blade as long as stem; *b* hairs over twice length *a* hairs, densely setose; the *d* about as long as *a* and the *c* about 1½× as long as the *a*. Caudum (Fig. 1g) small, anal blood gills short and blunt, appearing slightly bifid. Anal pseudopod with double row of sclerotized hooks, 8 smaller anterior and 8 larger posterior ones.

Pupa.—Retains larval exuviae. Thorax (Fig. 1a) with 3 pairs of cuticular spines, and a pair of posterior rounded tubercles. The anterior pair bear a short terminal seta and are setose. Prothoracic horn (Fig. 1b) small, with 16–17 lateral spiracular papillae and a reticulated dorsal surface. Abdominal segments 2–4 with slight lateral spines and large, setose dorsal processes; remainder of abdomen bare. Terminal processes appressed in male.

Female.—Wing length 1.1 (0.97–1.2, n = 11) mm; width 0.45 (0.42–0.48, n = 11) mm. Antennal length 0.64 (0.59–0.67, n = 10) mm.

Head: Brown, with coarse decumbent setae. Eyes black, contiguous. Frontal sclerite indistinct, pointed medially. Mouth parts brown, with lighter medial band. No mandibular teeth visible, labrum with stiff bristles along lateral edges and at tip. Palpus (Fig. 2a) yellow brown, 3rd segment swollen basally, bearing a large (12 μ avg. diameter), deep, round sclerotized pit containing about 17 capitate sensilla. Palpal ratio 2.33 (2.00–2.64, n = 10); 4th and 5th segments about equal and appearing fused; palpal proportions 25-40-79-36. Antenna (Fig. 2f) yellow brown, with short, sparse verticils; basal 8 flagellomeres stout vasiform, with 2 large trichoid tubelike sensilla and a varying number of trichoid and trichoid hornlike sensilla; distal 5 flagellomeres each only slightly longer than basal 8, without trichoid tubelike sensilla but with more numerous trichoid sensilla; apical papilla bearing 2

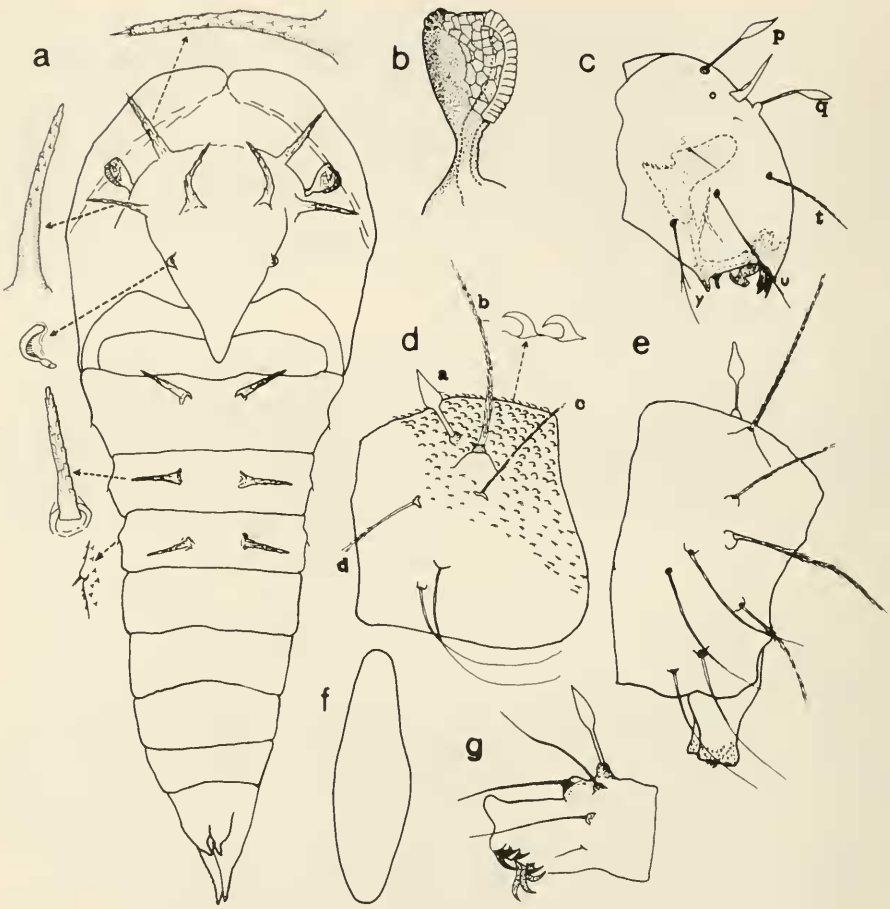

Fig. 1. *Forcipomyia pinicola*, immature stages. a, Pupa. b, Pupal prothoracic horn. c, Larval head. d, Larval body segment. e, Prothorax of larvae. f, Egg. g, Larval caudum.

small sensilla; antennal proportions 52-43-45-45-47-43-43-43-49-49-52-49-79; antennal ratio 0.77 (0.74–0.82, n = 10).

Thorax: Brown, except for dorsal part of pleura, which is yellow. Legs light brown, with coarse brown setae, hind tibial comb (Fig. 2b) with 7 stout setae and a setose tibial spur; all tibia bear lanceolate scales (Fig. 2c), with 2 on each fore tibia, 3 on each mid tibia, and 4 or 5 on each hind tibia, these scales averaging 25 μ in length; prothoracic tarsal ratio 1.31 (1.20–1.44, n = 11), mesothoracic tarsal ratio 1.06 (0.97–1.13, n = 11), metathoracic tarsal ratio 1.03 (0.95–1.18, n = 11); claws (Fig. 2i) equal, simple, strongly curved. Wing (Fig. 2e) unadorned, densely covered with dark, decumbent

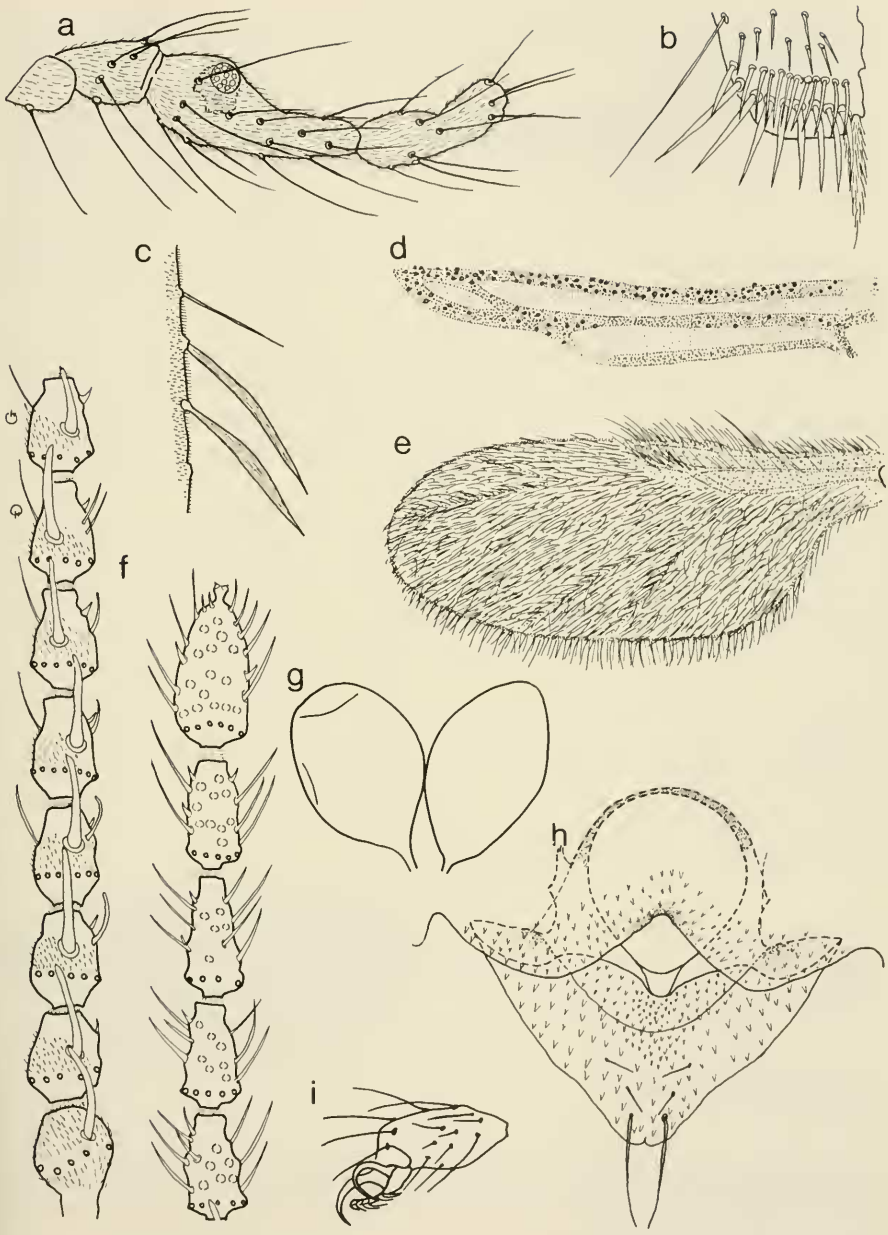

Fig. 2. *Forcipomyia pinicola*, female. a, Palpus. b, Hind tibial comb. c, Tibial scales. d, Wing radial cells. e, Wing. f, Antenna. g, Spermathecae. h, Terminal sternites. i, Tarsal claws.

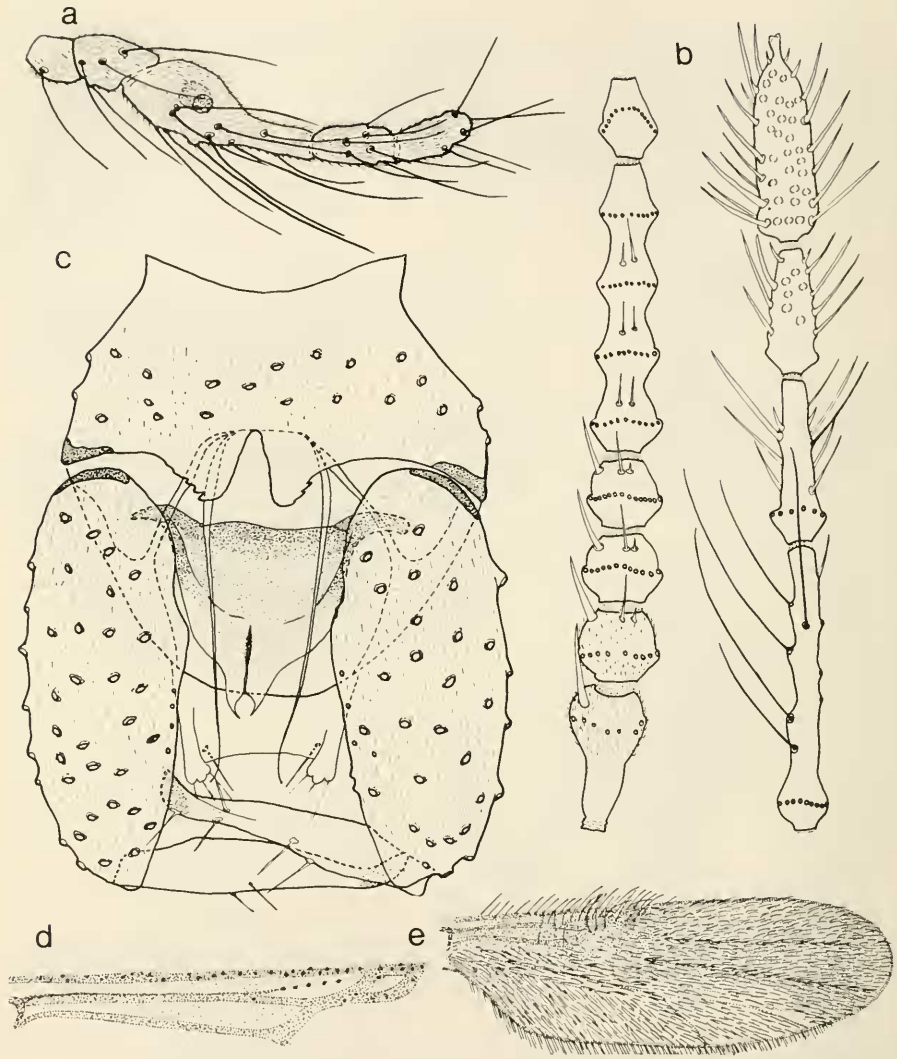

Fig. 3. *Forcipomyia pinicola*, male. a, Palpus. b, Antenna. c, Genitalia. d, Wing radial cells. e, Wing.

macrotrichia; macrotrichia of radial area suberect and darker; 1st radial cell obliterated, 2nd small (Fig. 2d); costal ratio 0.48 (0.44–0.50, n = 11). Halter translucent.

Abdomen: Golden brown, with dense covering of brown setae; pleura yellow, dorsal glands present. Two equal or slightly subequal, weakly sclerotized, ellipsoid spermathecae (Fig. 2g); averaging 101 × 54 μ and 90 × 49

μ. Caudal edge of 8th sternum (Fig. 2h) with deep V-shaped concavity; 9th sternum darkly sclerotized and rounded; 10th sternum with 1 pair of large terminal setae; cerci yellow.

Male.—Wing length 1.2 (1.1–1.3, n = 10) mm; width 0.40 (0.39–0.42, n = 10) mm. Antennal length 0.82 (0.74–0.89, n = 10) mm.

Head: Brown, with coarse setae on vertex. Eyes black. Palpus (Fig. 3a) light brown; 3rd segment swollen, with deep, round sclerotized pit containing 7–9 capitate sensilla; palpal ratio 2.76 (2.58–3.08, n = 10); palpal proportions 27-43-81-38-36. Antenna (Fig. 3b) light brown, with light brown plume reaching to base of 15th segment; basal flagellomeres subspherical, narrower distally, the 5th to 8th fused together; distal 4 flagellomeres elongate; the 11th with scattered coarse setae; the 12th with a single coarse seta and numerous trichoid sensilla; the 13th with numerous trichoid and trichoid tubelike sensilla and a bifid apical papilla lacking verticils; antennal proportions 72-45-43-40-36-38-38-45-45-157-92-67-115; antennal ratio 1.1 (0.98–1.1, n =10).

Thorax: As in female, with usual differences. Legs without scales. Claws bifid. Prothoracic tarsal ratio 1.10 (1.00–1.24, n = 9); mesothoracic tarsal ratio 0.87 (0.81–0.94, n = 10); metathoracic tarsal ratio 0.91 (0.86–0.98, n =10). Macrotrichia of wing shorter, lighter and less dense than those of female. First radial cell obliterated, 2nd nearly closed (Fig. 3d). Costal ratio 0.40 (0.39–0.42, n = 10).

Abdomen: Colored as in female. Genitalia as in Fig. 3c, 9th sternum small, bowl shaped, with a narrow, deep, caudomedian notch; caudal edge apparently hyaline. Ninth tergum elongate, with sclerotized caudal edge and bearing a clear flap with a dorsolateral seta on each side. Parameres slender and long, arising from widely separated bases. Aedeagus large and indistinct; with a sclerotized base and basal flanges; distal portion with cleft tip.

Distribution.—Eastern North America, Quebec to Florida.

Types.—Holotype, ♂, allotype, ♀, collected on the Fisher property, Brock Bridge Road, Laurel, Anne Arundel County, Maryland; USNM Type no. 72226; collected from a dead shortleaf pine as larvae on 24 March 1973. Topoparatypes 5 larvae, 5 pupae, 5 ♂, 10 ♀. Paratypes (collected by senior author unless otherwise noted) 58 ♀, 54 ♂ as follows. CONNECTICUT: Tolland Co., Storrs, July 1953, F. B. Lewis, 1 ♀. FLORIDA: Alachua Co., Gainesville, Chantilly Acres, 19 April 1967, F. S. Blanton, 1 ♀; Indian River Co., Fellsmere, 17 March 1956, no collector listed, 4 ♂, 4 ♀; Liberty Co., Torreya St. Pk., 22 April 1967, W. W. Wirth, 1 ♂, 1 ♀. MARYLAND: Anne Arundel Co., Odenton, 26 Oct. 1969, 1 ♂, 1 ♀ reared; 2 Nov. 1969, 2 ♂, 3 ♀ reared; 29 Nov. 1969, 2 ♂, 4 ♀ reared; 30 Nov. 1969, 5 ♂, 3 ♀ reared; 18 Jan 1970, 2 ♂, 3 ♀ reared; 22 Feb. 1970, 1 ♂ reared; 8 March 1970, 1 ♀ reared; 17 March 1970, 1 ♂, 1 ♀ reared; Montgomery Co., Forest Glen, W. W. Wirth, light trap, 15 April 1967, 1 ♀; 19 April 1968, 1 ♂, 1

♀; 4 May 1968, 1 ♀; 28 July 1966, 1 ♀; 20 Aug. 1966, 1 ♂; Prince Georges Co., College Park, University Golf Course, G. L. Williams, 13 March 1970, 1 ♀ reared; Glen Dale, hospital grounds, 24 Oct. 1969, 8 ♂, 6 ♀ reared; Somerset Co., Marion, Irish Grove Wildlife Sanctuary, 31 March 1970, 9 ♂, 3 ♀ reared. VIRGINIA: Fairfax Co., Falls Church, Holmes Run, W. W. Wirth, light trap, 22 Aug. 1960, 1 ♂; 4 Sept. 1960, 1 ♂, 1 ♀; 5 Sept. 1961, 3 ♀; 8 Sept. 1960, 1 ♀; 12 Sept. 1960, 1 ♂, 1 ♀; 22 Sept. 1961, 1 ♂; 3 Oct. 1961, 1 ♀; 17 Oct. 1960, 1 ♂; Warren Co., Shenandoah Farms, 25 Feb., 1973, 6 larvae, 2 pupae, 11 ♂, 13 ♀ reared. QUEBEC: Hull, malaise trap, 10 Aug. 1965, 1 ♀.

Biology.—This species is a common, occasionally abundant, resident of the oak-pine forests of the middle Atlantic states. Larvae can be easily located during the winter beneath the bark of dead and decaying trees, especially pines (hence the specific name). In a sample of 18 larval clusters, the following distribution of host trees was observed: Virginia pine (*Pinus virginiana* Miller) 33%, black oak (*Quercus velutina* Lamarck) 33%, shortleaf pine (*Pinus echinata* Miller) 17%, and loblolly pine (*Pinus taeda* L.) 17%. These trees have in common a relatively thick bark which separates cleanly from the wood, thereby creating a narrow space between two fairly smooth, hard surfaces. Species of trees which do not do this, such as chestnut oak (*Quercus prinus* L.) for example, are not a suitable habitat for this species. Both standing and fallen trees are used, but standing are preferred, probably because most trees are no longer in a suitable condition by the time they have fallen. The minimum time after death that a tree was occupied was about four months, and most trees were used for three or four years (maximum: five years) before becoming too rotten. The trunk portion of the tree is utilized exclusively.

Larvae have been observed under a dissecting microscope to feed in a grazing fashion, probably on anything they encounter which can be scraped off of the surface. In cleared specimens the stomach contents can be seen and consist mostly of detritus and fungal hyphae.

The larvae are apneustic and require a humidity greater than 60% to survive. However, if the humidity is much higher than 85% fungal growth becomes so rapid that the larvae are apparently overwhelmed. In nature they are capable of moving to the optimum humidity conditions, and their distribution of standing trees relative to true north was bimodal. About 66% (148 larvae) occurred between 15 and 80 degrees (mean 25°) and 34% (75 larvae) occurred between 210 and 320 degrees (mean 258°). Generally the region between 80 and 210 degrees was too dry and the region between 320 and 15 degrees was too moist. They encounter a special problem on young Virginia pines, where the bark is often too thin to maintain humidity. During dry periods they congregate in the slight pockets above branch stubs, which

are the last area to dry out completely. In order to determine how much moisture was necessary, samples of wood from beneath thriving clusters were brought to the laboratory, weighed on a Mettler balance, and dried in an oven to remove moisture. Oak wood samples were found to contain a mean of 74.8% water (70.9–79.8, n = 9) while pine samples averaged 63.0% (50.3–76.4, n = 6). The bark from these same samples contained considerably less moisture: Oak 32.1% (30.9–33.6, n = 3) and pine 26.2% (20.5–30.7, n = 4). This may explain why most of the larvae (161 of 180, or 89.4%) were found on the wood rather than the bark. The wood acts as a moisture (and food) source while the bark serves as protection from dehydration. Larvae also tend to be found close to the ground, with a mean height of 16 inches (5.0–48.0, n = 206).

The first three instars appear to last about one to two weeks each. By November the bulk of the population is fourth instar and remains that way throughout the winter. The larvae resist freezing well and have been thawed out of ice with no apparent ill effects. There is an indication that a diapause occurs during this stage because the length of time an individual remains a larva during the winter is more related to the date on which it was collected than to the temperature at which it is kept. Larvae collected after late October and kept inside emerge at about the same time as those left outside. Saunders (1924) also noted this habit with respect to *F. bipunctata* and suggested burying the larvae in a jar during the winter because of the low survival of those kept at room temperature. They are capable of moving and perhaps even feeding but survival is indeed very low in the laboratory.

In early March the larvae begin to pupate. Pupation takes about four days minimum, ten days maximum. The habits of the adults are unknown, although they have been light trapped in small numbers during the summer. Apparently either the adults or the eggs or some combination thereof oversummers, but the exact situation has not been determined. Larvae have not been found between 2 April and 22 October. In the same area, adults have been collected only between 15 April and 17 October. Although other species in this subgenus have two or more generations per year, we have been unable to locate a summer generation in this one. We could find winter larval sites with little effort, but were never able to locate summer sites even though we spent more time and effort at it. Saunders (1924), in speaking of *F. radicola*, suggests that some species may exhibit a summer ecology that is totally different from the winter one in order to explain his consistent inability to locate them. A more logical explanation is that summer generations do not occur.

Although nothing of the adult biology of this species was discovered during the course of this work, Lewis (1959) inadvertently provided some information on the subject. He light trapped adult ceratopogonids in Con-

necticut and described this species (as *bipunctata*) as well as true *F. bipunctata* as having three generations per year. More likely the peaks represent activity peaks, the first (late April) being the period of emergence, the second (mid June) being the peak period of mating or feeding, and the third (late August) being the period of egg laying. It is also possible that the three peaks represent three different species, *F. bipunctata*, *F. pinicola*, and another.

Lewis commented on the totally different life cycles for "*bipunctata*" at his two different study sites. He speculated on the possibility of subspeciation, but could not find any morphological differences. This was a reasonable conclusion in the context of the time, but the important point is that specimens were deposited and maintained for over 20 years allowing future checks on the taxonomic accuracy. Most ecological and ethological studies do not take this precaution, thereby preventing them from ever being verified. With the increased interest in ethological studies by persons not qualified to speak on taxonomy, the deposition of specimens becomes increasingly important. The failure to do so should cast doubts upon the value of such work.

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